

AMRAD NEWSLETTER

Amateur Radio Research and Development Corporation AUG/SEPT '83

Next Meeting

The next AMRAD meeting will be Monday evening, December 5, 1983, at 7:30PM. It will be in the Patrick Henry Library. This is the annual AMRAD business meeting. Three directors positions and two alternates are up for elections. They are:

Terry L. Fox, WB4JFI	Director
Paul L. Rinaldo, W4RI	Director
Elton A. Sanders, WB5MMB	Director
Richard Barth, W3HWN	Alternate
Dave Borden, K8MMO	Alternate

Please be sure to attend this meeting, as not only are there going to be elections, but we will also be discussing where the club will be going in the next year.

Hamfests

The Vienna Wireless Society will be holding their annual Winterfest(TM) on Sunday, February 26, 1984, in the Vienna Community Center. There will be flea markets both indoors and out.

The Ninth Trenton Computer Festival will be held at Trenton State College, Trenton NJ on April 14 & 15, 1984. In addition to the indoor commercial exhibits and lectures, there will be an outdoor flea market. There is also a dinner banquet Saturday night.

Shuttle Update

STS-9 will be launched late November, 1983. The exact date is not certain at this time, but it appears to be either Nov. 28 or 29. Rumor has it that this mission may be an abbreviated one, it's too early to tell how this will affect the amateur radio portion of the mission. The next newsletter will have more information on the launch.

In addition to the Goddard Amateur Radio Club relaying the audio from the mission on the AMSAT repeater (146.235/146.835 MHz), Metrovision will be relaying the mission audio and video over its ATV repeater (426.25 MHz) whenever there is something of interest. The video will be LIVE and in COLOR, so dust off the old downconverters. We may even be able to see Owen Garriott, W5LFL talking to other hams around the country!

Special Interest Groups

AMRAD has several continuing Special Interest Groups (SIGS) devoted to specialized portions of the Amateur Radio and Computer hobbies. These SIGS are a great opportunity for people to exploit particular facets of our hobby, or to find out about these areas. Contact the people listed with the SIG description for further information.

Direction Finding SIG

The direction finding SIG is a newly formed group that is interested in developing an automated direction finding network. The work so far is based on the Doppler Systems DDF-3000 series of direction finders (see June 1981 73

Magazine for description). Plans are to hook these units to a small computer, which will relay the directional information to a central computer via a radio link (possibly using packet radio). Bob, WB4APR is the contact for this DF SIG.

Hearing Impaired Communications

AMRAD has been involved in new ways to provide communications for the hearing impaired for a few years now. We still support HEX (Handicapped Education eXchange), which is a multi-line, multi-mode message system. Over the same phone line it will accept either Bell-103 or TTY calls. AMRAD is continuing its research into the use of inexpensive home computers as TDD devices. Anyone interested in this project should contact either Dick Barth, W3HWN, or Barry Strassler, KA3KDF.

Packet Radio SIG

AMRAD has been, and continues to be a leader in amateur packet radio. Now that level 2 has been standardized, we are moving our sights to level 3. At the present time, we are leaning toward using X.25 virtual circuits for our level 3 protocol, but are open for suggestions. In addition, work needs to be done on levels 4 and up. Now that people are starting to actually use packet radio, we need to work extra hard. Dave, K8MMO is the packet radio SIG contact.

Spread Spectrum SIG

Another project AMRAD has been pushing into is spread spectrum communications techniques. We received an STA from the FCC to conduct some tests and send them a report of the results. The report just went in to the FCC, and we are ready to build on our knowledge. We are going to file with the FCC for another STA, this time limiting most of our work to VHF and UHF frequency hopping. We are looking for people willing to take an ACTIVE interest in spread spectrum. Hal, WB3KDU is in charge of the spread spectrum SIG.

Newsletter Problems

This issue of the newsletter is marked August/September 1983, even though it is being sent out way late. The editor apologizes for the tardiness, and will make sure it doesn't happen again. The next issue is about a week behind this one, with the following issue shortly behind it. There WILL be newsletters for the missing months, we are not dropping ANY issues (other than combining August and September in this issue). By the way, the July issue was the membership list, sent out to members only.

I didn't realize how involved it was to produce a monthly newsletter, and bit off more than I could chew at first. After spending the last several years busy designing and soldering, I couldn't see how much time it takes to produce this newsletter. Paul warned me, but you have to learn first-hand sometimes. I think the situation is partially resolved now, so we should be getting back on track soon. What would help is if I received as much information for the newsletter as possible in computer form (Wordstar files would help). Thank you for your patience in this matter.

Frequency Control of ICOM Portable Radios

Terry Fox, WB4JFI
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Last year, AMRAD asked for and was granted an STA from the FCC to allow us to conduct experiments using spread spectrum in the amateur bands. Although I was listed on the STA as one of the participants, I was already heavily involved with packet radio and didn't have a lot of time to devote to this new endeavor. In addition, it seemed like spread spectrum might end up costing a lot of money to really do it right. Most of our emphasis was placed on HF, and I didn't want to buy an expensive HF rig and then immediately have to butcher it up for this new mode of communications. I ended up listening on my old NCX-5 to Paul doing some tests on 20 meters using a commercial spread spectrum radio.

This year may be different. Some of the AMRAD crowd gets together every Saturday for pizza at the local pizza place in Vienna. One Saturday we were discussing the various problems with spread spectrum as applied to amateur radio, and whether or not we should continue our experiments in this area. The biggest problem we had was that of finding a cheap radio that was easily available that could serve as a test bed for our experiments. By that time we had sort of decided to limit our efforts to a frequency hopping system, most likely on VHF and UHF. After talking about this during almost the whole pizza session through a sea of antennas (stubby duckies on our ICOM IC-2ATs, of which there were at least half a dozen), my subconscious finally realized that my conscious self wasn't going to figure out the obvious. It then started sending smoke signals about using these marvelous little radios in front of us as the test bed. The IC-2AT has become almost a standard in AMRAD, and since there are so many out there, it seems almost natural to make it the radio we use. After discussing this idea for a while, we left the pizza place and went to my house for an in-depth design conference.

The first order of business was for me to get out a screwdriver and demolish my IC-2AT, while Sandy Hal, and Dave looked at the schematics. After popping off the back of the radio, I quickly located the wires going from the thumbwheel switches to the programmable divider chip. Actually the connections are made with a flexible printed circuit board and not individual wires. This flexible board attaches through two sets of pins to the rear main board, with the pins straddling the programmable divider chip (see Figure 1. for a diagram of the pinout of this connection). A quick look at the schematics revealed that the thumbwheel switches on the radio asserted a high on the appropriate line rather than grounding the lines. If the internal thumbwheel switches are set to the zero position, they are effectively removed from the circuit, and an external device could control the frequency by bringing the same lines high. This was confirmed by taking an external set of thumbwheels and wiring them into the radio, which worked fine.

The next step was to wire the IC-2AT to a computer. Having a spare parallel port on one of my S-100 boards, I decided to go that way. This turned out to take the most time of the whole project. Since I didn't have a manual for the board in question, I had to guess the port locations for the parallel port. After a lot of lost time finding the parallel port and its control port, we were ready for computer control of the ICOM. Using a BASIC interpreter, I sent various frequency commands to the IC-2, and checked the result with another IC-2 (since there were several in the room to use, as long as modifications weren't required). I was able to program the IC-2AT hooked to the computer to any frequency within its range in 10 kHz steps. Now the fun really began!

Being careful to hook the IC-2AT to a dummy load/power meter, I started writing programs to test the synthesizer by moving the frequency of the radio at certain rates. Due to the way the synthesizer is designed, there is no easy way of telling if it is out of lock or not, and once it

is out of lock, the only way to get it to re-lock is to drop out of transmit. It does have an unlock pin, but this pin seems to be a direct output of the digital phase comparator, which means it has a lot of pulses whose width depends on the lock condition of the synthesizer. ICOM takes these pulses and integrates them over a long period of time (greater than a second). Obviously, this out-of-lock indicator is too slow for any real application, and even for our experimentation, so we came up with another way to test for lock, unscientific as it was.

We asked for a volunteer to donate the use of a second IC-2AT, which Sandy finally agreed to. We then wired his rig to the same port that my radio was hooked to. We now had two radios hopping to the same frequencies at the same time (I know a lot of people that wish the hopping synchronization problem could be cured this easily!). We then hooked a scope to the audio output of the second radio, allowing us to see what was coming out. As the radios were moved from one frequency to another, there was generally a short burst of noise followed by a sinusoidal (or ringing) pattern with decreasing noise riding on it (see Figure 2). As the synthesizers locked, the ringing waveform decreased in level, until it disappeared completely, leaving a steady trace until the next time the frequency was changed. Another interesting phenomenon regarding this lock-up period was noticed. Almost as soon as the noise disappeared from the ringing, audio transmitted by one radio was recovered by the other, at least according to the scope. The obvious question at that point was whether or not the audio could be used once the noise was gone, but while the synthesizer was still locking, as indicated by the ringing waveform. My opinion is that it probably is usable, but only if the same type radios are being used at both ends. If the same type radios aren't being used, the synthesizer's time constants aren't going to be the same, so the frequencies the radios are operating on will not necessarily match during the locking period.

The time the synthesizer was stabilizing (as shown by the audio waveform discussed above) varied, depending on the distance between the old and new frequencies. Figure 3 shows the rough times measured for the synthesizer to lock up, both for the noise period and the total lock-up (as indicated by the audio signal totally stabilizing). As can be seen, a 1MHz hop can cause the radio to be out of lock for a relatively long period of time. The maximum dwell-time on any frequency that most people consider effective is 100 milli-second. Obviously, the Icom radios cannot be expected to hop a Megahertz within this dwell-time spec. and convey much intelligence. Therefore, the Icoms cannot be used to hop over a Megahertz without some help.

One of the first ideas we came up with when we saw what the audio output looked like during hopping was that if the audio was suppressed during the noise bursts (the most objectionable part of the hopping signal), the sudden noise bursts would be gone, and the human ear and mind would integrate out the blanked-out areas to a large extent. Since the human voice is very redundant, small losses in voice transmissions could be tolerated. Obviously, any mode of transmission that requires fully accurate reproduction (such as packet radio or slow scan television) could not use this system. AMRAD is working on several ideas to help reduce, or eliminate this lock-up period, both for the IC-2AT project, and for use in just about any other type of frequency hopping radio. We will report more on these ideas as they develop.

Since this first test seemed to work, we put both radios back together, and declared the work of the day a success. The next step was to find a couple Icom HTs that we could leave hooked to a computer for an extended period of time. Dave graciously volunteered his pair of IC-3ATs. Sandy

also volunteered the use of his spectrum analyzer. About a week after the initial test described above, the new equipment showed up at my house. Later that day, Hal and I purchased a couple of Commodore 64 computers, primarily to use in these frequency hopping tests. For the money, these computers seem to be a good buy, and plenty of documentation is available for them.

I then hooked one of the IC-3ATs to the parallel port of the 64, and let Hal write various BASIC programs to stroke the IC-3AT, while it was hooked to the spectrum analyzer. He came up with several iterations of random number generators to move the IC-3s frequency. The main thing to realize is that each digit of the frequency is encoded in BCD (0 to 9), while most random number generators can generate numbers over the whole binary range (0 to F hex). As a result, there are

holes in the frequency control (when A thru F hex are sent to the radio) that can cause uncertain frequencies to be programmed in. The programmer should be sure that improper frequencies aren't accidentally programmed into the HT, as this could result in synthesizer going out of lock, causing the transmitter to stop transmitting, which requires the transmitter to be turned off.

This is as far as we have gotten so far. We are looking for people to help us with the Icom hoppers, and other spread spectrum experiments. There are many different areas of experimentation in the spread spectrum tests we are running. Just a few of these areas include the design of fast locking PLLs, special RF circuitry, computer programming, and audio processing. Anyone interested in helping out, please contact Hal, WB3KDU, or write AMRAD.



FIGURE 1. DIVIDER PINOUT

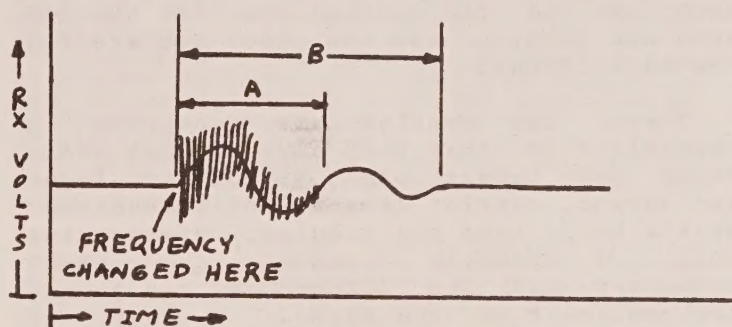


FIGURE 2. AUDIO OUT DURING UNLOCK

! Frequency Hop	! "A" Period	! "B" Period	!
! 1 MegaHertz	! 60 msec.	! 110 msec.	!
! 100 kiloHertz	! 40 msec.	! 80 msec.	!
! 10 kiloHertz	! 25 msec.	! 40 msec.	!

Figure 3. Out-of-Lock Periods For IC-2AT

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CHEAP 202 MODEMS

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The Gaithersburg Hamfest was another bonanza as far as finding cheap 202 modems for packet radio. I found about 40 Auto-answer/Manual Originate 202 modems with back channel capability. These cards have a DB-25 and DAA connector on one end and an 18 pin edge connector on the other. They are about 7 X 13 inches full of TTL and OP-AMP chips but with four large VADIC black modules on one end. After a week of frustration and having run out of clip leads trying to get all the handshaking satisfied, I finally started at the module end and worked forward. What I found was that two of the modules are for the 202 send and receive, and the other two are for the back channel.

These 202 modules are complete in themselves in that they have nominal audio input and output pins, RS-232 data input and output, carrier detect, and transmitter enable built into the modules. Discovering this, I promptly removed the DB-25 connector and the 202 modules and junked the remainder of the board. I traced the receiver module to understand the carrier detect circuitry and have included a partial schematic as figure 1. Notice that the entire schematic of figure 1 is included in the single black 202 receiver module. Nothing except power leads was necessary to make the receiver operate with the VADCG Packet board. All of the other pins are left unconnected except for jumpering pin 11 to 13 which connects the first audio stage filter to subsequent stages. Pin 32 is a receiver clamp and pin 43 is a high impedance point for observing eye patterns on a scope. The transmitter was almost as simple, requiring only one transistor to give a positive low signal to enable the transmitter tones from the

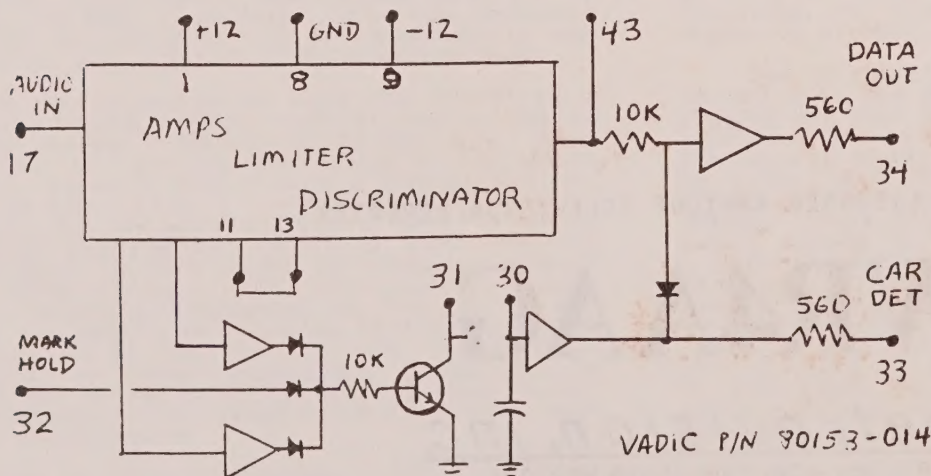


Figure 1. This block diagram of the VADIC 202 Receiver Module lumps all of the audio processing circuitry into one area and attempts to represent the output and carrier detect circuitry. All of this circuitry is contained within the Blackbox Receiver Module.

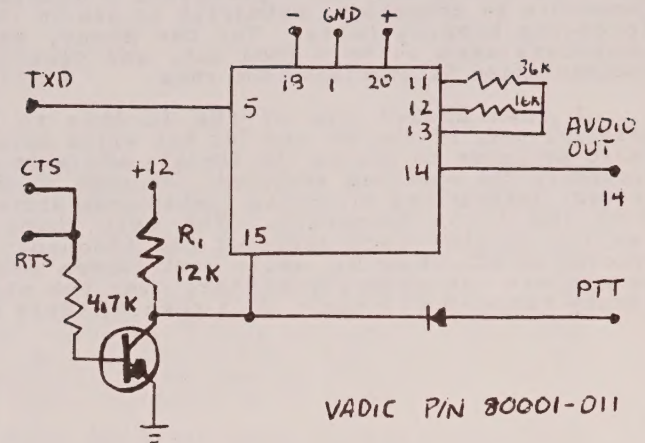


Figure 2. The VADIC 202 Transmitter module needs only a single transistor to interface it to the VADCG Packet board and the PTT of the transceiver. It is assumed that the pins 11, 12, and 13 can be used to tweak the frequency or level of the output.

request-to-send line as shown in figure 2. For my transceiver, the same transistor is used to key the transmitter PTT line. R1 is a pull up resistor and the diode prevents the microphone PTT from also enabling the 202 tones during voice transmissions. The unused pins 4 and 6 are for generating a soft carrier, whatever that is, and generating an echo suppressor tone respectively. They should be left unconnected.

ADDENDUM: In retrospect, the mark hold transistor in the receiver is probably designed to do the RTS action for the transmitter. In this case, connect pin 31 of the receiver to pin 15 of the transmitter and connect your RTS from the packet board to receiver pin 32 through a 4.7k ohm resistor. I have not tried this yet.

By eliminating all unnecessary line control logic on the original modem motherboard, current consumption of the two 202 modules was reduced to less than 30 MA from the + and -12 volt supplies. The resulting packet modem powers nicely from my 12 volt DC to -12 volt DC converter described in my previous article for my mobile/portable packet station.

As long as they last, I can mail these modems out for \$25 each which includes postage.



SPREAD SPECTRUM

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Spread Spectrum News

A lot has been happening in amateur spread spectrum during these last few hot summer months. Much of the activity comes from a few projects that are in the completion stages and a number of new projects just getting under way. I'll try to give a summary of some of these activities and some details on some of the experiments.

Chuck Phillips, N4EZR, has unveiled another one of his completely homebrew vhf frequency hoppers which I had a chance to examine in some detail. The units are about the size of a cigar box and run on 12 volts. These unit hop in a small preset band in the 140 to 170 Mhz range and have a dwell time preset to 100 milliseconds. The hopping sequence is also preset in an onboard EPROM which is scanned out under the control of a pseudo-random number generator. The use of an EPROM gives the user the option of selecting which channels the units will visit and allows specific channels to be bypassed.

The front pannel has few controls, which I found extremely easy to operate. Besides the volume, squelch and power; there were two additional controls which are used only in spread spectrum mode. These controls are used to set the frequency hopping control mode and the "key" value for the psuedo-random number generator.

The hopping sequence is controlled by three thumbwheel switches which allow the user to enter a seed value. This seed value is used to initialize the psuedo-random number generator and determines the order in which the channel will be visited (the hopping sequence).

The mode switch is used to select the technique by which the frequency hoppers will determine the starting channel for each transmission. There are three positions which can be selected. The first position of the mode switch cuts off the hopping circuits and allows the units to be used as conventional NBFM transceivers.

The second position of the mode switch selects frequency hopping with a single home channel. In this mode, each time a unit begins to transmit, it starts on a single, common home channel. The unit uses the home channel to send an encoded signal which alerts the other frequency hopping units that a frequency hopping transmission has started.

After the alert signal has been sent, the unit begins to hop through the frequency hopping sequence setup by the thumbwheel switches. The home channel is selected from the first hop of this sequence. Each time a frequency hopping unit transmits, the same procedure is used to synchronize the transmitter and receiver.

When a unit is not transmitting, it automatically resets itself to the home channel and begins to monitor it for the coded alert signal. This mode of synchronization always uses the same hop sequence for each transmission. In the mobile environment the average time for a mobile transmission is short and the same set of channels will be revisited for each transmission.

To remedy this situation, a additional mode is included in the frequency hoppers and is selected by the third mode switch position. This position is called "run" mode and differs from the second mode by using an always moving home channel.

The frequency hopping circuits run continuously when the unit is switched to run mode. In this mode, when the unit begins to transmit it chooses the next hop as the home channel and transmits the alert signal. The receiving unit's frequency hopping circuits are also continuously running; this has the effect of changing the receiving channel in step with transmitter. Together the transmitter and receiver share a common channel, which allows the receiver to hear the transmitters coded alert signal.

A built-in feature of the run mode is the use of a "look aside" channel which is automatically monitored by the frequency hopper. This channel is used when one of the two units falls out of synchronization due to some unusual condition such as a power failure. The look aside channel is used to manually transmit a special encoded signal to the other frequency hopping unit which is still in run mode. When the unit detect this signal, they automatically fall back to the initial channel in the hopping sequence, which allows the units to resynchronize.

When a frequency hopper is done with a transmission it automatically signals this fact to the other frequency hopper unit by transmitting a special encoded signal on the last hop for which the microphone is depressed. The other unit detects this "end of transmission" signal and resets the hopping sequence to the home channel for the mode two transmissions. For the run mode of transmission, the end of transmission signal is not as important since both frequency hopping units are continuously hopping through the hopping sequence and do not reset to any home channel.

Networking with several frequency hopping transceiver can be done with Chuck's units. A net of frequency hoppers is established by three factors; first, the internal channel EPROM must be setup to contain the same sequence of channels, which is done at "installation" time according to Chuck. Second, the control mode switch must be all set to the same control mode. Lastly, the thumbwheel switches must all be set to the same seed value.

When these three conditions have been correctly set, a number of units can hop in a net. Nets can use the same home channel and still remain in their separte nets if at least one of the three above mentioned factors are different.

Chuck's frequency hopping radios have attracted some commerial interest at this writting, mainly in the law enforcement sector. During the next STA period, we will be testing these radios to see how they fare in the amateur radio service. Anyone interested in more infformation on Chuck's radios, please contact him through AMRAD via AMRAD's address.

A New Frequency Hopping Experiment

What can you make with an ICOM-3A and a PET computer? Answer: A software controllable frequency hopper. This is exactly what AMRAD members Terry Fox, WB4JFI and Dave Borden, K8MMO and Sandy, WB5MMB did one afternoon. The bug bit them after the informal Saturday Pizza Hut get together more as a dare than anything. Well, schematics were examined, ICOM 3AT and 2AT were disassembled and reassembled and new cards were popped into the computer. By evening, an ICOM 2AT continued next page...

sat on Terry's workbench with all sorts of wires connecting it to a Z-80 computer in an old IMSAI 8080 frame. The first experiment was a success. The unit frequency hopped up to 50 times a second! Not bad for an afternoon of tinkering. At any rate, be sure to see Terry's article in this issue of the newsletter.

Second STA Program Formulated

A series of experiments has been devised for the second spread spectrum STA. The experiments will include three experiments: first, a proposal for an experimenter's frequency hopping beacon which will operate on 220 Mhz, second, frequency hopping experiments in the 144, and 220 Mhz band and lastly a direct sequence experiment.

Each of these experiments is designed to explore some new aspect of spread spectrum in the amateur service. In the first STA, the experiments allowed us to gain the important initial experience with spread spectrum. Most of this activity was centered around frequency hopping experiments. In the second STA we are focusing in experimental circuits and procedures.

Dave Borden, K8MMO has pointed out the need for standardizing the acquisition and handshaking between spread spectrum units much as has been done with protocols for data communications. Spread spectrum requires accurate operations at high speeds between different self synchronized units, the issues are very similar to data communications which can lend itself to a protocol treatment. Hopefully we will be able to look forward to an experimenter's spread spectrum protocol.

Sandy, WB5MMB has been speculating on a very fast lock up, phase locked loop circuit for frequency hopping, which can make this part of the frequency hopping problem less of a task. Hal, WB3KDU has been experimenting with digitally controlled oscillators.

Computers are also making their appearance in our experimentation which will give us the flexibility to change parameters and protocol around in a much faster time than wiring a board.

In the second STA we would like to apply these ideas to actual on the air experimentation.

Drop-In Channel Assignments

A concept that is making it's way around the frequency management circuit these days is the idea of drop-in channel assignments. Drop-in assignments are based on the notion that guard-band calculation between conventional channels are based on the capabilities of old equipment and techniques. Consider the guard-band situation between repeater channels. They are primarily based on the premise that NBFM receivers could not separate signals that are too close together.

What we are left with today are receivers that can separate those signals without getting even a little out of breath. This leaves spectral room between channels which is not wide enough for a conventional NBFM signal. However it may be wide enough for some of the new modulations techniques such as amplitude compandered sideband

(ACSB) which is being tested currently at several commercial sites around the US and by the FCC.

Drop-in channel assignments are also being considered for frequency hopping spread spectrum. A frequency hopper be designed to only visit frequencies which are in the guard-bands. The short time that the signal is actually present on any frequency is very small (1/30 second or less) which will appear as some form of low intensity shot noise. This should be ignored by the repeater and mobile units in an amateur NBFM operation. Even with a close in near-far effect, the actual experienced signal energy from a "drop-in" frequency hopper should be slight.

One advantage which a drop-in frequency hopper may have over a system such as ACSB is the fact that many commercial NBFM repeaters have a form of automatic frequency control (AFC) which will pull the receiver off the repeater center channel. This feature allows the repeater to hunt off frequency for a mobile which is accidentally off channel and requires alignment. A constant carrier signal on a drop-in frequency such as ACSB may trick the commercial repeater into thinking that it is hearing an off frequency mobile unit. A frequency hopper would appear to the repeater as a brief noise pulse, and the repeater would ignore the hopper.

Spread Spectrum NOPR

As you are probably aware, the Commission is considering incorporating spread spectrum modulation techniques into the amateur radio service as a fully legal technique. We think this is a good idea. The introduction of the home computer and the integrated circuit is causing a transition in amateur radio that is probably as significant as the transition from morse code to amplitude modulated voice techniques did in the early part of this century.

However, as promising as this transition is, new ideas must be subject to regulation that permits all parties to enjoy the benefits of new technology without interfering with conventional modes of communications.

Herein lies a problem, the Commission is proposing that only holders of the Extra class amateur license be allowed to use spread spectrum techniques. The reason for this proposed restriction is that the Commission believes only Extra class licenses have the technical expertise to operate without causing interference to other operators.

We understand the Commission's desire to limit the potential for interference, but we question the rational of the proposed license restrictions. Our experience indicates that the class of license has little to do with actual technical ability. In fact, we found that amateurs who experiment with new modes of communication tend to have other than an Extra class license.

One of the Commission's goals for the Amateur Radio Service is to promote experimentation and innovation at all levels of the hobby. We do not believe the Commission's interest can be served by implementation of this sort of restriction.



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Published 12 times per year by Mike Stone WB9QCD
P.O. Box H, Lowden, Iowa 52255 0408



THE DEAF AND THE TTY

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Weitbrecht, TDDs, and the EIA

Readers of this column should observe subtle changes to the format heading. I resigned as Executive Director of Telecommunications for the Deaf, Inc. to seek greener employment pastures elsewhere. My heart is still with telecommunications (and television, computers, radios, and electronics), and I enjoy writing, hence the continuation of this column. I have agreed to remain in my present position until a new offer is firmed up.

Robert H. Weitbrecht developed the first workable TTY modem, and for the first few years, his Applied Communications Corp. reaped huge rewards for his efforts, which were patented. Since success breeds competition, several TTY modem manufacturers entered the market. Some of them did not survive, but others did. Then, several years later, the market shifted towards portable TDDs. And again, some manufacturers were successful, while others were not. These inroads upset Weitbrecht, as he claimed his patent rights were being infringed. His competitors, backed by knowledgeable engineers, denied these accusations. Weitbrecht never took his case to court.

All of Weitbrecht's competitors shared a common complaint, that he would not share the technical specifications of his TTY with them. As an entrepreneur, it wouldn't make sense for him to share his trade secrets with his competition. The only choice left to his competitors was to reverse-engineer their modems to match his. In fact, they considered their designs to be superior. This led to compatibility problems among TTY/TDD models, some of which persist to this day.

Informal attempts were made by some manufacturers to try to compromise with Weitbrecht, but he would not budge, claiming that with his patents he held the upper hand. Even when some AT&T engineers told him that his modems were too loud for the telephone lines, he resisted change. Sadly, Weitbrecht's intransigence caused the technological world to pass him and his company by. Applied Communications Corp. took a nosedive, and then closed its doors in 1982. Weitbrecht vowed to have nothing to do with ASCII, claiming that bit for bit, Baudot was faster, simpler, and superior. He disliked the portable TDDs, claiming that the sturdy model 28s were keenly superior. While this may be true to a degree, when marketing something, customer needs and tastes cannot be ignored. The world of microprocessors utterly perplexed him, pushing him deeper into his defensive shell.

By profession, Weitbrecht was not even an engineer! He majored in Astronomy in college and developed his technical knowledge through his

involvement with ham radio, especially with the RTTY machines.

Ultimately, one manufacturer urged the Electronic Industries Association to get involved with TDD standards. TDI and the EIA worked hand-in-hand, beginning in 1981 and concluding very recently, in staging a series of meetings among manufacturers, telephone companies, and other interested agencies. Strangely enough, this manufacturer never attended any of the EIA meetings. Only half of the manufacturers attended the meetings with some regularity. Even Weitbrecht did not attend the first meetings, and when he did attend, there was no interpreter for him. This created the usual communications gap, causing one EIA official to comment, "It is Weitbrecht against the whole world." One leading manufacturer walked out during an afternoon session and never returned when their technical specifications were outvoted. This manufacturer had sided with Weitbrecht, and their walkout added to Weitbrecht's distress. Finally, at the last meeting held in Philadelphia in June, the participants tentatively approved a set of technical specifications, subject to public comment upon distribution.

The biggest controversy during these meetings was over the Baudot direct-connect signal levels. Some wanted the maximum signal level to be -9 DbM, and the minimum level to be -11 DbM. Weitbrecht didn't agree with these levels, and at least one major manufacturer listened to Weitbrecht, causing this manufacturer to end up holding not only the bag but also an inventory of a few thousand unusable TDDs.

Other areas of debates included whether one or two signalling channels should be used and what type of test equipment should be used to set signal levels. It was felt by some that such test equipment might cost in excess of \$10,000.00, which would place a large capitol investment burden on the smaller manufacturers. It turns out that one manufacturer was using test equipment that was about twenty years old.

I think the EIA standards are the best thing that has ever happened to the TDD industry, even though some manufacturers have been burned in the process. When distortion occurs on voice over the phone, it can often be overcome. When TDDs get garbled, the parties don't have much of a choice, they can either try again, possibly wasting another call, or get frustrated and give up.

As a sidelight, it was nice knowing that there were two licensed hams among the round table of participating manufacturers. I have agreed to reach them on the air soon.

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PROTOCOL

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Spread Spectrum Packeteering

The AMRAD Spread Spectrum Special Interest Group (SIG) is active once again. This august body is dedicated to the advancement of spread spectrum communication (as you would guess from the name). In the last incarnation, they performed some experiments and wrote a report to the FCC on what they had discovered. I have persuaded them to take me on in the capacity of protocol experimenter. That is, spread spectrum requires lots of protocols, similar to that we use in normal data communication. For instance, assume we are experimenting with the hopping mode of spread spectrum. We need a base frequency to begin on, usually called the service channel. All work begins on that frequency. We may then have some pre-arranged (defined by the protocol) signal to begin hopping. When our trancivers arrive at frequency 1, assuming they lock up they can then proceed to frequency 2. If they fail to lock up, then we could have them return to the service channel, or to the last frequency lock was achieved on, or whatever our protocol dictates.

Also, the exact hopping sequence must be defined. Another chance for protocol experimentation. It looks like a good chance to broaden my horizons and fine tune a protocol. We have no X.25 type protocol in this area from which to begin this work, so it should be a challenge. What really got me interested was that I was challenged to figure out how to packet using frequency hopping (it is easy with direct sequence). I am still thinking about it. I am studying ARPA and their spread spectrum portable packet station. This looks like a real challenge. You will be hearing more about spread spectrum protocols in this column.

Another Protocol! - NO!

Don Lund, WA0IQN, called with the sad story that the gang in the Boulder, Colorado were having trouble. It seems that several of them are running Vancouver boards (very understandable now that the price has dropped), but they could not speak with TAPR boards. I asked what protocol he was using for this and he said Vancouver. I knew at once what was wrong. Our founding packet father, Doug Lockhart, has redone the Vancouver protocol again, and changed the address field. This new protocol does not speak with the old Vancouver protocol or AX.25. I told Don the correct answer is to use AX.25 and I shipped him a disk. All old Vancouver software and new Vancouver software should be trashed. The latest Hank Magnuski AX.25 ROMs work fine with TAPR AX.25. AMRAD can supply this software if you send a floppy disk or four (4) 2708 ROMs. AX.25 is the official protocol to use on OSCAR 10 and for terrestrial work also. All protocol wars are over and our mission now is to continue on to Level 3 protocol definition (which has unfortunately stalled).

Packet Computing

I think I have finally found the answer to using my computer on the packet local area network. The Digital Research Multi-Programming Monitor Control Program for Microprocessors (MP/M II - a registered trademark of Digital Research) would just fit the bill. I could continue to use my computer as I want, my wife could use a separate terminal in the kitchen, while a packeteer could use a port to leave mail and play games. The real interesting part of this excellent (but expensive) system is the security features, which of course are required for radio use. The packeteer can only run programs available to that User number. The directory (DIR - a program in MP/M) will only show the packeteer what is available to that User number. It seems that the

only way the system could be defeated is to allow the packeteer to change their User number.

Passwords are available for files, but if the user does not even know the file is available, that seems even better. The problem I see with this is that I cannot let the packet user assemble or compile a program, or download a program. If the packeteer downloaded a program to change user number for example, I am dead. I know I would still have the passwords, but once a program is on the system that the packeteer wrote, the disk is accessible directly (given enough time to figure out what disk controller I am using, etc.), and the packeteer could window the disk subverting MP/M's password system. This whole radio security thing is an interesting problem to try to solve, given most of my friends would try to break the system just because it is there.

Some people have already tried to solve this problem by changing their operating system built in commands to unique commands, etc., but all those systems are easy to get into given that you can get a new program on the target system. I have a friend locally who is working on MP/M and will be watching his progress closely. I may purchase it if he gets it running this century (it is hard to get up and running). Using Digital Research's MPM II may have solved my problem here.

Language Wars Again

Another language has entered the packet arena as a potential candidate. C, written by Dennis Ritchie about ten years ago, has possibilities of being very useful for packet work. One of our local packeteers, Jon Bloom, KE3Z, is coding AX.25 in C for use on his California Computer Systems Z80 S-100 system. Jon has an SIO on his CPU board, and with the addition of another board with two state machines (discussed here and in QEX in connection with AMRAD's STD computers) packets can fly from it. The resultant code can then be downloaded and run on the STD bus machine.

I see the need here for an S-100 board with an SIO and the necessary state machine hardware, but I do not have time to build it and neither does Jon.

Why C you ask? C is one step above assembly language. It allows structured programming, still allows bit twiddling, and is easy to code (once you learn the language, of course). Jon is busy coding. Actually Jon had written most of the code in assembly language, but then tried to change it. He found that assembly language was not easy to change. He counts this all as a good learning experience, as he now understands AX.25. This all interests me since we need an agreement on a Level 3 protocol, and then code, which Jon could probably be persuaded to take on when the time comes. Currently, he has the transmit packet and receive packet routines working. Next he will do an AX.25 monitor routine, followed by terminal input/output routines.

John Tanner called from Australia to report that there are close to twenty packet users down under with Vancouver boards. He wants to run the AX.25 protocol (an excellent plan), and I am shipping him a disk. He reported contact on twenty meters between VK2BVD in Australia and ZL1AOX in New Zealand (who has previously packeted with AMSAT's Tom Clark). The twenty meter path was chosen since the ten meter path would not work. Both stations used Bell Standard 202 modems. Great DX from that end of the earth. They are all looking forward to using AMSAT OSCAR 10, which is available to them on several good passes daily. Maybe I should fire up the twenty meter rig, assuming I could solve the noise problem and the tuning problem (202 modems are hard to tune in).

Appendix D. Layer 2 AX.25 State Table

	State	:	I with:	I with:	RR with:	RR with:	REJ with:	REJ with:	RNR with:	RNR with:	SABM :	DISC :	UA :	DM :	FRMR :
	: Poll :	out P :	Final :	out F :	Final :	out F :	Final :	out F :	Final :	out F :	either:	either:	either:	either:	either
S1	Disconnected	:	DM :	:	DM :	:	DM :	:	DM :	:	UA,S5 :	DM :	:	:	:
S2	Link Setup	:	SABM,S2 :	:	:	:	:	:	:	:	UA,S5 :DM,S1 :	S5 :	S1 :	:	:
S3	Frame Reject	:	FRMR :	:	FRMR :	:	FRMR :	:	FRMR :	:	UA,S5 :UA,S1 :	:	SABM,S2 :	SABM,S2 :	:
S4	Disconnect Rqst	:	DM,S1 :	:	:	:	:	:	:	:	DM,S1 :UA,S1 :	S1 :	S1 :	:	:
S5	Information Xfr	:	RR :	I :	I :	I :	I :	I :	S9 :	S9 :	UA :	UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:
S6	REJ Frame Sent	:	RR,S5:	I,S5 :	I :	I :	I :	I :	S15 :	S15 :	UA,S5 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:
S7	Waiting Acknow.	:	RR :	I :	I,S5 :	I :	I,S5 :	I :	S9 :	S12 :	UA,S5 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:
S8	Device Busy	:	RNR :	RNR :	I :	I :	I :	I :	S10 :	S10 :	UA :	UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:
S9	Remote Device Busy	:	RR :	RR :	I,S5 :	I,S5 :	I,S5 :	I,S5 :	:	:	UA,S5 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:
S10	Both Devices Busy	:	RNR :	RNR :	I,S8 :	I,S8 :	I,S8 :	I,S8 :	:	:	UA,S8 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:
S11	Waiting Acknow. and Device Busy	:	RNR :	RNR :	I,S8 :	I :	I,S8 :	I :	S10 :	S13 :	UA,S8 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:
S12	Waiting Acknow. and Remote Busy	:	RR :	RR :	I,S5 :	I,S7 :	I,S5 :	I,S7 :	:	:	UA,S5 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:
S13	Waiting Acknow. Both Devices Busy	:	RNR :	RNR :	I,S8 :	I,S11 :	I,S8 :	I,S11 :	:	:	UA,S8 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:
S14	REJ Sent and Device Busy	:	RNR :	RNR :	I :	I :	I :	I :	S16 :	S16 :	UA,S8 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:
S15	REJ Sent and Remote Busy	:	RR,S9 :	RR,S9 :	I,S6 :	I,S6 :	I,S6 :	I,S6 :	:	:	UA,S5 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:
S16	REJ Sent and Both Devices Busy	:	RNR :	RNR :	I,S14 :	I,S14 :	I,S14 :	I,S14 :	:	:	UA,S5 :UA,S1 :SABM,S2:SABM,S2 :	SABM,S2:	:	:	:

Corrections To AX.25 Level 2 Document

Terry Fox, WB4JFI
1819 Anderson Rd.
Falls Church, VA 22043

The first part of this article corrects some errors in the AX.25 level 2 protocol document in the Second ARRL Amateur Radio Computer Networking Conference. The second part describes briefly how we in AMRAD feel the SSID field should be standardized (generated by Paul, W4RI).

The first error is a simple typo. On page 4, in the second column under Frame Structure, the next to the last line has "ans", which should be "and".

The second error is in the next paragraph, the word "above" should be "later".

Next, turn to page 6. At the top of the second column, under item 2, "bit 2" should read "bit 1".

Just under that, under item 3, "bit 6" should read "bit 5".

On page 8, in the first column, and the fourth paragraph, strike "CMDR or", since command reject frames are only used in an unbalanced mode.

Below Fig. 9 in the same column, under item 1, "bits 1-8" should read "bits 0-7".

Under item 2, "bit 10" should be "bit 9".

Under item 3, "bit 14" should be "bit 13".

Next, on page 9, column 1, under Address Field Operation, another typo crept in. "dvice" should be "device".

Another typo is in the Collisions of Unnumbered Commands paragraph (page 11, column 1). "Indicates" should read "indicated".

There are also a couple errors in the appendixes. Both appendix A and B show SABM frames with PID fields. Since the PID is considered part of the Information field, and there is no Information field in supervisory or unnumbered frames, these diagrams are wrong. Either cross out the PID field in both diagrams, or change the SABM control field to an I control field.

The last errors occurred in the State Table (Appendix D). The previous page shows the corrected State Table. Most of the errors in the original State Table were minor, but it was easier to reproduce the whole table.

The above constitutes the total corrections to the level 2 AX.25 document as of the date of this newsletter. Anyone having discovered additional potential errors should contact AMRAD.

The following are a few items that should be discussed regarding level 2. Please let us know of your feelings.

Now that the FCC has allowed us to identify in the frames instead of requiring a cw id, we need to standardize the SSID sub-field of the address fields. This would allow repeaters, host computers, and beacons to automatically transmit frames without needing to identify in cw. The following is a recommendation from Paul, W4RI regarding this problem, which AMRAD is following.

0000 First packet terminal of an amateur station.
0001 Second terminal or third host station.
0010 Third terminal or second host station.
0011 First host station.

0100 First repeater or packet-switching station.
0101 Second repeater or packet-switching station.
0110 Third repeater or packet-switching station.
0111 Reserved.

1000 First auxilliary station.
1001 Second auxilliary station.
1010 Third auxilliary station.
1011 Reserved.

1100 Beacon operation.
1101 Earth operation.
1110 Reserved.
1111 All call as defined by level 2 protocol.

Another area that may need a change has to do with a bit we originally eliminated. It was in the address field (bit 1), and it showed whether a frame was a command or a response. We made all supervisory frames responses only, and unnumbered frames during a connection either a command or a response, but not both. This saved having to add the bit in question somewhere in the address field of the AX.25 frame, and since this bit seemed to be superfluous, it was dropped.

Now however, we have found out that it is possible to reach an ambiguous state without either adding this bit, or making some assumptions about the state of the link. So far, this ambiguous state hasn't been reached as far as I know, but it may happen sooner or later.

There isn't enough room in this issue to describe in detail what can cause this ambiguous situation to crop up, so I will follow up in the next issue of the newsletter. There is room to add the bit back in the address field if we want, although this might affect present software. The other answer is to make sure all software is bulletproof by making some assumptions regarding timeouts and the proper acknowledgement of frames.

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WD4IWG/R is an open repeater for fm voice and digital communications, especially for experimental modes. It is located at Tyson's Corner, McLean, VA. It features semi-private autopatch available to licensed members. Frequencies are: 147.81 MHz in, 147.21 MHz out. The repeater director is Jeff Brennan, WB4WLW.

WB4JFI/R is a 1200-baud half-duplex packet repeater in Falls Church, VA and may be accessed via WD4IWG/R frequencies.

WB5MMB/R is a 1200-baud simplex packet repeater on 147.585 MHz from Vienna, VA, soon to become K3NA/R from Frederick, MD.

The AMRAD CBBS, 703-734-1387, is operated by Terry Fox, WB4JFI. The system accepts 110, 300, 450 and 600-baud ASCII, Bell 103.

Handicapped Education Exchange, 301-593-7033, is operated by Dick Barth, W3HWN. HEX accepts 110/300-baud ASCII and Baudot deaf TTY/TDD calls.

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